decision problems and recursively enumerable sets. It is proved that there exists an infinite recursively enumerable set (i.e., a set of non-negative integers which is the range of some one-to-one recursive function) whose characteristic function is not recursive. In fact, two such sets are exhibited, namely a creative set and a simple set using variants of Post's well-known proofs. This chapter concludes the first part of the book.

Part II is concerned with three applications of the theory so far developed. Chapter 6 treats the unsolvability of various combinatorial problems, in particular the word problem for semigroups. The unsolvability of the word problem for groups (shown by Novikoff and, independently, Boone) is stated, but not proved. Chapter 7 is devoted to Hilbert's tenth problem, i.e., the problem whether there exists an algorithm for deciding whether any polynomial equation of the form

$$P(x_1, \cdots, x_n) = 0,$$

where P has integers as coefficients, has a solution in integers. This problem is still unsolved. Here the author also presents his own results on diophantine predicates. This part closes with Chapter 8 which deals with mathematical logic; it contains a proof of Gödel's incompleteness theorem and establishes the existence of a first-order logic with an unsolvable decision problem.

Part III continues the development started in Part I. It is concerned with the Kleene hierarchy, computable functionals, the recursion theorems, and degrees of unsolvability. Post's problem is stated and its solution (by Friedberg and, independently, Mucnik) mentioned, but not presented. The last chapter ends with a treatment of recursive ordinals and a few remarks about extensions of the Kleene hierarchy. There is an appendix in which some number-theoretical theorems needed in the text are proved in detail, namely, the prime factorization theorem and the Chinese remainder theorem. Finally, there is a four-page bibliography and an index.

J. C. E. DEKKER

P. R. Halmos, *Lectures on ergodic theory*. Tokyo. The Mathematical Society of Japan, 1956. 7+99 pp. $2.00.

This book is the first work on ergodic theory to appear in book form since E. Hopf's Ergodentheorie appeared in 1937. Its contents are based on a course of lectures given by the author at the University of Chicago in 1955. The first of these facts makes the book very welcome. More so since the book is written in the pleasant, relaxed and clear style usually associated with the author. The material is organized very well and painlessly presented. A number of remarks ranging from the serious to the whimsical add insight and enjoyment to the reading of the book.

The topics covered are as follows: recurrence, the ergodic theorems, a general discussion of ergodicity and mixing properties including the two mixing theorems. There is a general discussion of the relation between conjugacy and equivalence. For the particular case of ergodic transformations with a pure point spectrum this relation is discussed together with other properties in some detail. A particularly full and clear account is given of the two theorems concerning the topological sizes of the sets of weak mixing and strong mixing respectively; the first stating that "In general a measure preserving transformation is a mixing"; the second, that "In general a measure preserving transformation is not a mixing." The book ends with a discussion of the still unsolved problem of the existence of a σ-finite invariant measure equivalent to a given one and a list of some unsolved problems.

The author, in the apology (preface) to the book, asks the reader to regard these notes as "designed to rekindle" interest in the subject. From this point of view and considering the excellent and effortless style of the book it is doubly regretful that the material discussed is so restricted in time and person. There is almost no indication of work done during the last decade, and the reviewer cannot but be disappointed that the reader is left unaware of the recent sparks of interest found by workers in such branches of ergodic theory as, for instance, those related to probability theory, number theory, abstract ergodic theory, dynamical systems in general and geodesic flows in particular.

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